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CLAIMS

(45)

1. A method for screening for titanium binding peptides comprising contacting titanium with a population of phage wherein said phage of said population collectively express a library of different peptide sequence; recovering titanium bound to phage particles via peptide sequence from said population by centrifugation; proliferating the obtained titanium binding phage particles in bacteria; and repeating a panning operation comprising the contact of titanium with the proliferated titanium binding phage expressing a peptide sequence on phage particles and concentrating proliferating titanium binding phage clones.
2. A titanium binding peptide obtained by the method for screening according to claim 1.
3. A titanium binding peptide comprising an amino acid sequence shown in SEQ ID NO: 1.
4. A titanium binding peptide comprising an amino acid sequence shown in SEQ ID NO: 1, wherein at least one amino acid is deleted, substituted or added in the amino acid sequence.
5. The titanium binding peptide according to claim 4, wherein the 1, 4 and 5th amino acid residues of the amino acid sequence shown in SEQ ID NO: 1 are conserved.
6. The titanium binding peptide according to claim 5, comprising an amino acid sequence shown in SEQ ID NO: 2 wherein



the 2nd lysine is substituted by alanine.

7. A titanium binding peptide comprising an amino acid sequence shown in SEQ ID NO: 3.

8. A titanium binding peptide comprising an amino acid sequence shown in SEQ ID NO: 3, wherein at least one amino acid is deleted, substituted or added in the amino acid sequence.

9. The titanium binding peptide according to claim 8, wherein the 1, 4 and 5th amino acid residues of the amino acid sequence shown in SEQ ID NO: 3 are conserved.

10. The titanium binding peptide according to claim 8, comprising amino acid sequences shown in SEQ ID NOs: 4 to 14, wherein the 1 to 5th and 7 to 12th amino acid residues are substituted by alanine, respectively.

11. The titanium binding peptide according to claim 8 or 9, comprising an amino acid sequence shown in SEQ ID NO: 15, wherein alanine is added/inserted to the N terminal of the amino acid sequence shown in SEQ ID NO: 3.

12. The titanium binding peptide comprising amino acid sequences shown in SEQ ID NOs: 16 to 24.

13. A titanium binding peptide comprising amino acid sequences shown in SEQ ID NOs: 16 to 24, wherein at least one amino acid is deleted, substituted or added in the amino acid sequence.



14. A titanium binding peptide comprising an amino acid sequence shown in SEQ ID NOs: 25 to 38.

15. A titanium binding peptide comprising amino acid sequences shown in SEQ ID NOs: 25 to 38 wherein at least one amino acid is deleted, substituted or added in the amino acid sequence.

16. The titanium binding peptide according to any one of claims 2 to 15, being chemically modified.

17. The titanium binding peptide according to any one of claims 2 to 16, wherein titanium is metal titanium, titanium alloy or titanium dioxide.

18. A titanium-peptide complex, wherein the titanium binding peptide according to any one of claims 2 to 16 is bound to titanium.

19. An artificial titanium binding protein being a conjugate of the titanium binding peptide according to any one of claims 2 to 16, with a functional peptide or a functional protein.

20. The artificial protein according to claim 19, wherein the functional peptide or the functional protein is a peptide or a protein that cooperates with a titanium binding peptide to form a two-dimensional crystalline by self-assembly.

21. The artificial protein according to claim 19, wherein the functional peptide or the functional protein is a peptide or a protein comprising a peptide sequence having a



cell-recognizing ability such as cell adhesion ability.

22. A titanium-artificial protein complex, wherein the artificial protein according to any one of claims 19 to 21 is bound to titanium.

23. A titanium binding chimeric protein being a conjugate of the titanium binding peptide according to any one of claims 2 to 17, with a labeled substance or a peptide tag, or with a conjugate with a nonpeptide compound.

24. A titanium-chimeric protein complex, wherein the chimeric protein according to claim 23 is bound to titanium.

25. A titanium binding phage expressing the titanium binding peptide according to any one of claims 2 to 17 on the particle surface.

26. A titanium-phage complex, wherein the phage according to claim 25 is bound to titanium.

27. A method for refinement of a titanium surface or for forming a titanium particle, wherein the titanium binding peptide according to any one of claims 2 to 17 is used.

28. A method for refinement of a titanium surface, for forming a titanium particle, or for aligning titanium particles, wherein the titanium binding artificial protein according to any one of claims 19 to 21 is used.



29. A method for refinement of a titanium surface or for forming a titanium particle, wherein the titanium binding chimeric protein according to claim 23 is used.

30. A method for aligning titanium or for forming a titanium particle, wherein the titanium binding phage according to claim 25 is used.

31. An implant material comprising the titanium-artificial protein complex according to claim 22 as an active ingredient.

32. A silver binding peptide comprising an amino acid sequence shown in SEQ ID NO: 1.

33. A silver binding peptide comprising an amino acid sequence shown in SEQ ID NO: 1, wherein at least one amino acid is deleted, substituted or added in the amino acid sequence.

34. The silver binding peptide according to claim 33, wherein the 1, 4 and 5th amino acid residues of the amino acid sequence shown in SEQ ID NO: 1 are conserved.

35. The silver binding peptide according to claim 34, comprising an amino acid sequence shown in SEQ ID NO: 2, wherein the 2nd lysine is substituted by alanine.

36. A silver binding peptide comprising an amino acid sequence shown in SEQ ID NO: 3.

37. A silver binding peptide comprising an amino acid sequence



shown in SEQ ID NO: 3, wherein at least one amino acid is deleted, substituted or added in the amino acid sequence.

38. The silver binding peptide according to any one of claims 32 to 37, being chemically modified.

39. A silver-peptide complex, wherein the silver binding peptide according to any one of claims 32 to 38 is bound to silver.

40. A silver binding artificial protein being a conjugate of the silver binding peptide according to any one of claims 32 to 38, with a functional peptide or a functional protein.

41. A silver-artificial protein complex, wherein the artificial protein according to claim 40 is bound to silver.

42. A silver binding chimeric protein being a conjugate of the silver binding peptide according to any one of claims 32 to 38, with a labeled substance or a peptide tag, or with a conjugate with a nonpeptide compound.

43. A silver-chimeric protein complex, wherein the chimeric protein according to claim 42 is bound to silver.

44. A silver binding phage expressing the silver binding peptide according to any one of claims 32 to 38 on the particle surface.

45. A silver-phage complex, wherein the phage according to



claim 44 is bound to silver.

46. A method for refinement of a silver surface or for forming a silver particle, wherein the silver binding peptide according to any one of claims 32 to 38 is used.

47. A method for refinement of a silver surface, for forming a silver particle, or for aligning silver, wherein the silver binding artificial protein according to claim 40 is used.

48. A method for refinement of a silver surface or forming a silver particle, wherein the silver binding chimeric protein according to claim 42 is used.

49. A method for forming a silver particle or for aligning silver, wherein the silver binding phage according to claim 44 is used.

50. A silicon binding peptide comprising an amino acid sequence shown in SEQ ID NO: 1.

51. A silicon binding peptide, comprising an amino acid sequence shown in SEQ ID NO: 1, wherein at least one amino acid is deleted, substituted or added in the amino acid sequence.

52. The silicon binding peptide according to claim 49, wherein the 1, 4 and 5th amino acid residues of the amino acid sequence shown in SEQ ID NO: 1 are conserved.

53. The silicon binding peptide according to claim 50,



comprising an amino acid sequence shown in SEQ ID NO: 2, wherein the 2nd lysine is substituted by alanine.

54. A silicon binding peptide comprising an amino acid sequence shown in SEQ ID NO: 3.

55. A silicon binding peptide comprising an amino acid sequence shown in SEQ ID NO: 3, wherein at least one amino acid is deleted, substituted or added in the amino acid sequence.

56. The silicon binding peptide according to any one of claims 50 to 56, being chemically modified.

57. A silicon-peptide complex, wherein the silicon binding peptide according to any one of claims 50 to 56 is bound to silicon.

58. A silicon binding artificial protein being a conjugate of the silicon binding peptide according to any one of claims 50 to 56, with a functional peptide or a functional protein.

59. A silicon-artificial protein complex, wherein the artificial protein according to claim 58 is bound to silicon.

60. A silicon binding chimeric protein being a conjugate of the silicon binding peptide according to any one of claims 50 to 56, with a labeled substance or a peptide tag, or being a conjugate with a nonpeptide compound.

61. A silicon-chimeric protein complex wherein the chimeric



protein according to claim 60 is bound to silicon.

62. A silicon binding phage expressing the silicon binding peptide according to any one of claims 50 to 56 on the particle surface.

63. A silicon-phage complex, wherein the phage according to claim 62 is bound to silicon.

64. A method for refinement of a silicon surface or for forming a silicon particle, wherein the silicon binding peptide according to any one of claims 50 to 56 is used.

65. A method for refinement of a silicon surface, for forming a silicon particle, or for aligning silicon, wherein the silicon binding artificial protein according to claim 58 is used.

66. A method for refinement of a silicon surface or for forming a silicon particle, wherein the silicon binding chimeric protein according to claim 60 is used.

67. A method for forming a silicon particle or for aligning silicon, wherein the silicon binding phage according to claim 62 is used.

68. A method using the titanium binding peptide according to any one of claims 2 to 17, the silver binding peptide according to any one of claims 32 to 38, or the silicon binding peptide according to any one of claims 50 to 56, as a probe of atomic force microscope (AFM).